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SURVEY OF EMISSION-LINE GALAXIES: UNIVERSIDAD COMPLUTENSE DE MADRID LIST[1]

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ABSTRACT

A low-dispersion objective-prism survey for low-redshift emission-line galaxies (ELGs) is being carried out by the University Complutense de Madrid with the Schmidt telescope at the German-Spanish Observatory of Calar Alto (Almería, Spain). A 4° full aperture prism, which provides a dispersion of 1950 Å mm^{-1}, and IIIaF emulsion combination has been used to search for ELGs selected by the presence of Hα emission in their spectra. Our survey has proved to be able to recover objects already found by similar surveys with different techniques and, what is more important, to discover new objects not previously cataloged.

A compilation of descriptions and positions, along with finding charts when necessary, is presented for 160 extragalactic emission-line objects. This is the first list, which contains objects located in a region of the sky covering 270 deg^2 in 10 fields near $\alpha = 0^h$ and $\delta = 20°$.

Subject headings: galaxies: general — galaxies: Seyfert — surveys

1. INTRODUCTION

During the last two decades many efforts have been made on the discovery of large samples of active galaxies. Several surveys have been carried out and a number are still in progress, discovering a wide variety of objects. The classical review by Kinman (1984a) summarizes the more important surveys published prior to 1983, with particular emphasis on possible observational biases.

Although many surveys are now being carried out using large telescopes, grisms, and CCD cameras as detectors, the small field of view of this instrumental setup makes the process very time consuming. When a survey is undertaken with the aim of covering a wide field, it is preferred to use a Schmidt telescope and photographic emulsion and to select the candidates via their colors or their spectral features.

The first technique, object selection by their colors, implies the acquisition of multicolor plates, that is, multiple exposures of the same field through two or three different filters, and then looking, for instance, for objects bluer than usual. The pioneering work of this kind was the survey of Haro (1956) who took U, B, and V plates with the Tonantzintla 66 cm Schmidt telescope and discovered 44 blue galaxies. A multicolor survey of this kind is being performed with the Schmidt telescope at Kiso Observatory (Japan) with the aim of finding ultraviolet-excess galaxies (Takase, Noguchi, & Maehara 1983; Takase & Miyauchi-Isobe 1984, 1991, and references therein). Recently another survey for UV-bright galaxies has been initiated using the plate collection of the Montreal-Cambridge-Tololo survey of subluminous blue stars (Coziol et al. 1993).

The second survey technique involves the use of objective prisms. With such instrumentation it is possible to search for ultraviolet-excess galaxies as was done by Markarian and collaborators (Markarian 1967; Markarian, Lipovetskii, & Stepanian 1981). They obtained spectra at low dispersion (1800 Å mm^{-1}) near the Hγ line, using IIaF emulsion, and found 1532 UV-excess objects in 1133 fields covering 17,000 deg^2 (Lipovetskii, Markarian, & Stepanian 1987). Using a higher dispersion objective prism and higher contrast emulsion, the presence of emission lines in the spectra of galaxies can be detected as shown by Smith (1975), who conducted a survey for emission-line galaxies (ELGs) and quasars with a dispersion of 1740 Å mm^{-1} at Hβ in IIIaJ plates.

Most of the surveys of this kind have been carried out in the blue looking for objects which show emission lines like [O II]λ3727 Å or [O III]$\lambda\lambda$4959,5007 Å using IIIaJ emulsion and different telescopes and prisms. The Curtis Schmidt telescope with the thin UV prism at Cerro Tololo Observatory has been used to carry out three explorations: the Tololo survey (Smith, Aguirre, & Zemelman 1976; Bohuski, Fairall, & Weedman 1978), the University of Michigan (UM) survey (MacAlpine, Lewis, & Smith 1977; MacAlpine, Smith, & Lewis 1977a,b; MacAlpine & Williams 1981), and the Calán-Tololo survey which is still in progress (Maza et al. 1989; Maza & Ruiz 1989). The survey by Wasilewski (1983) and the Case Low-Dispersion Northern Sky Survey (Pesch & Sanduleak 1983; Pesch, Sanduleak, & Stephenson 1991, and references therein) employed the Burrell Schmidt at Kitt Peak observatory. Finally, the survey of Kunth, Sargent, & Kowal (1981) was made with the 1.24 m UK Schmidt telescope.

A number of surveys have been carried out in the past selecting particular objects for the presence of Hα in emission. This number has increased recently due to the development of the IIIaF emulsion and the improvement in plate sensitivity in the red by means of hypersensitization techniques. While many of the surveys were aimed to detect galactic objects, that is, plane-

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tary nebulae, Be stars, Wolf Rayet stars, T Tauri stars, novae, and other emission-line objects (see McCarthy 1984 for a review), only a few cases are known of surveys for detecting extragalactic objects with Hα in emission.

Kinman (1984a) has undertaken a survey for Hα ELGs with both the Curtis and Burrell 0.6 m Schmidt telescopes using a 10° prism, IIIaF emulsion, and RG630 filter to limit the spectral range to 6400–6850 Å, with a dispersion of 400 Å mm^{-1} at Hα. He finds 0.5 galaxies per deg^2 and a larger number of the redder Seyfert 2 galaxies per unit area of the sky than the Markarian survey (Kinman 1983). With the same instrumentation, Moss et al. (1988) conducted a survey for Hα emission in two rich nearby clusters, Abell 347 and Abell 1367, with the aim of investigating the effect of environment on star formation in clusters. They detected 69 Hα emission-line galaxies. Allowing for the redshift limit of the survey technique, all Markarian (5) and Wasilewski (15) galaxies in the surveyed region were recovered, and many additional emission-line galaxies were detected. Wamsteker et al (1985) carried out a similar survey with plates taken with the ESO 100/162 cm Schmidt telescope at La Silla observatory. They used a 4° objective prism yielding a dispersion of 1500 Å mm^{-1} at Hα and IIIaF+RG630 plate-filter combination. They published a catalog of 113 faint southern galaxies with Hα emission.

Finally, the Second Byurakan Spectral Sky Survey (SBSS) (Markarian, Stepanian, & Erastova 1987) is also based on emission-line detections and is intended to find not only blue galaxies but also all types of ELGs and blue stellar objects. In this survey, which is in progress, each field is observed in three colors: blue and UV region (IIIaJ+1°.5 prism), green region (IIIaJ+GG495+3° prism), and red spectral range (IIIaF+RG2+4° prism). The last instrumental setup provides 1097 Å mm^{-1} at Hα and is able to find ELGs up to a limiting magnitude of 19.5 in 120 minutes of exposure time. They claim that more than 50% of ELGs are selected in the red region and, what is more important, that surveys which do not use the Hα region for selecting ELGs are missing a significant fraction of objects, mainly low-excitation ELGs. Their procedure has proved to be well suited for finding interesting objects: a blue compact dwarf galaxy SBS 0335-052 and some other galaxies found in the Second Byurakan Survey show unusually low heavy-element abundances (Izotov et al. 1990, 1991).

A significant number of star-forming galaxies are missed by optical surveys carried out in the blue. On one hand, objects with strong interstellar absorption and low-excitation escape detection because of the strong Balmer decrement and the weakness of the [O III] lines. As pointed out by Dennefeld, Karoji, & Belford (1985) a significant fraction of *IRAS*-selected ELGs will not be detected by blue objective-prism surveys, since these objects tend to have strong Hα+ [N II] lines but weak [O III] lines. Salzer & MacAlpine (1988) conclude that *IRAS* has detected a subset of the actively star-forming galaxy population which has been at least partially missed by objective-prism surveys in the blue, although not necessarily to the degree suggested by Dennefeld, Karoji, & Belford (1985), since these objects would presumably exhibit strong [O II] λ3727 Å emission, due to their low-excitation nature, and most of them would be easily detected via blue surveys.

On the other hand, Kunth & Sargent (1986) investigated the causes of the paucity of known very metal-poor galaxies. No dwarf ELGs were known to have heavy-element abundances lower than those of IZw18 with an abundance about $\frac{1}{30}$ of the solar value. They elaborated on the detectability of such objects, assuming that oxygen-poor galaxies as deficient as $\frac{1}{100}$ of the solar value do exist, and calculated the fluxes and ratios of emission lines for a very metal-deficient H II region spectrum using Stasinska (1980) models. The [O III] lines in these low-metallicity H II regions are expected to be very weak. Therefore, one of the conclusions of the Kunth & Sargent (1986) work is that a more promising way to find very metal-poor emission-line objects is probably by the UV excess or by using IIIaF emulsion with objective prisms and looking for Hα emission.

The number of metal-poor galaxies is rather small. However, these objects are particularly interesting since they are excellent candidates to be "young galaxies" in the evolutionary sense, that is, they are undergoing their first major episode of star formation, as POX186 (Kunth, Maurogordato, & Vigroux 1988). Since the interstellar matter in these galaxies is only weakly contaminated by stellar evolution, their study could provide valuable information about the primordial helium abundance, and therefore it could place constraints on the different big bang models. The study of such objects will also provide important clues to issues concerning the formation, photometric, and chemical evolution of galaxies. Limits on their present-day abundance will also constrain the star formation and gas content history of typical field galaxies.

Surveys of this type can be also quite important in many different ways. The Hα luminosity is a very good and direct measurement of current star formation, since it is directly related to the number of massive stars (see, e.g., Kennicutt 1992), and the best way to quantify the current star formation in the local universe is by using an Hα-selected sample of emission-line galaxies. This sample could also provide valuable information about the role of environment on global star formation. Does the environment play a dominant role or are more intrinsic factors like the luminosity or past history of star formation more important? What are the preferred sites of star formation: dwarf, starbursting galaxies, or more quiescent, normal galaxies? How does the fraction of cluster galaxies of different types found in emission in clusters compare with that of field galaxies (Moss et al. 1988)? What is the connection between interactions involving disks galaxies and bursts of star formation (Keel & van Soest 1992)?

Objective-prism surveys are also particularly efficient at identifying active galactic nuclei. There are great difficulties in obtaining a complete sample of Seyfert galaxies from an objective-prism or color survey since each method is biased against certain types. Many Seyfert 2 galaxies are missed in objective-prism surveys based primarily on UV excess, while Wasilewski's objective-prism search is more sensitive to the narrow emission lines of the Seyfert 2 galaxies but missed an appreciable fraction of the Seyfert 1 galaxies (Osterbrock 1987). It seems that the only way of having such a complete sample and to find the relative numbers of various types of Seyfert galaxies is to obtain individual slit spectra of all galaxies, down to the desired magnitude limit, in a field (Osterbrock & Martel 1993). Selecting galaxies by their Hα line in emission could overcome this inconvenience finding more faint, reddened

Seyfert 1 and 1.5 galaxies as Osterbrock & Martel (1993) suggest to do in the Wasilewski area.

Considering the previous results of the above mentioned surveys and having in mind the chief aim of finding new metal-poor galaxies, the UCM survey has been initiated with these general objectives: (1) to identify and study new young, low-metallicity galaxies, (2) to carry out the classification and determination of the overall properties and completeness of the sample, (3) to determine the spatial distribution and luminosity function of the new galaxy population, (4) to compare our survey with other ones and to find out differences in the samples obtained with various objective-prism techniques, (5) to study the overall relation between the far-infrared properties and the optical behaviour of the star-forming galaxies, (6) to determine the evolutionary status and the different stellar subjacent population of the objects in order to detect any effect of evolution in the starburst phenomena, and (7) to quantify the properties of the star formation in the local universe.

This paper provides the first list of the objects found by the UCM survey. In the next section the observational procedure is outlined. In § 3 we describe the method that has been followed to classify the objects found. A preliminary comparison, with the data available up to now, with other surveys is presented in § 4. Finally, in § 5, we report the main results. Follow-up observations, both spectroscopy and imaging, of the UCM galaxies included in this catalog are in progress in order to address some of the purposes of the survey, and the results will be published in forthcoming papers.

2. OBSERVATIONAL PROCEDURE

The Schmidt Telescope of the Calar Alto German-Spanish observatory (Almería, Spain), equipped with a full aperture objective prism, is being used in this survey. The 80/120 cm f/3 Schmidt telescope and 4° objective prism combination provides a dispersion of 1950 Å mm^{-1} at Hα, and the plate scale is 86″ mm^{-1} (Birkle 1984). By using IIIaF emulsion, whose sensitivity decays dramatically at 6850 Å, and a RG630 filter, a useful spectral range from 6400 to 6850 Å is selected. Since this bandpass excludes the strong night sky emission in the blue-visual, longer exposures can be made without severe plate fogging. This instrumental setup is able to record the Hα line in emission for objects up to $z = 0.04$.

The IIIaF plates were hypersensitized by baking them in an atmosphere of N_2 gas at 65 °C for 6 hr prior to exposure. Different exposure times were tested and 2 hr was found to be the best choice and taken as standard. By careful manual guiding using stars brighter than $m = 9$, and without widening for recording very faint objects, the spectra are generally kept to a width of 0.06 mm. Plates taken with bad seeing or poor guiding were rejected after visual inspection. Dispersion runs along the north-south axis. A well-exposed spectrum is about 0.4 mm long. Field coverage is 5.5×5.5 deg^2 in plates 24 cm wide. The field centers, dates of observation, seeing and number of candidates found are listed in Table 1. The total number of galaxies of unknown redshift or $z < 0.04$ are also tabulated for each plate. These data, obtained from the Catalogue of Principal Galaxies (Paturel et al. 1989), are useful to stress the differences between galaxy populations from field to field. A diagram with the fields surveyed is depicted in Figure 1. These plates were taken during an observing run in 1986 October with dark nights and very transparent atmosphere. Although the overlapping spectra of close objects lying together along a north-south axis could lead to spurious identifications, only a small fraction of cases are found in each field which can be eliminated after inspection of direct images on the Palomar Observatory Sky Survey (POSS) prints in order to identify their nature.

Quality standards for the plates analyzed were as follows: (1) good seeing (no worse than 3″) and excellent guiding, (2) no cloud interference, (3) no exposure interruption, and (4) telescope near the meridian, that is, hour angle between 21^h30^m and 2^h30^m.

Plates have been carefully searched by visually scanning with a low-power (10×) binocular microscope in a scanning frame that allowed coverage in a series of horizontal strips 1 cm wide. Each plate was inspected by at least three independent observers. A last review of all objects found provides the final selection which is checked against the POSS plates. The visual inspection of the plates, although efficient, is rather subjective.

TABLE 1

JOURNAL OF OBSERVATIONS

Plate No.	Plate Center RA(1950)	DEC(1950)	Date of Observation	UT	Seeing (arcsec)	Catalogued Galaxies	Hα emission candidates
A194	$23^h23.2^m$	+22°28.7′	1986 oct 27	20^h46^m	1	35	34
A195	$00^h48.5^m$	+00°16.3′	1986 oct 27	22^h52^m	2	54	18
A197	$23^h55.2^m$	+22°39.8′	1986 oct 28	20^h50^m	2	38	13
A198	$00^h44.7^m$	+21°47.7′	1986 oct 28	23^h58^m	2	19	17
A200	$22^h47.6^m$	+22°08.2′	1986 oct 29	19^h43^m	2	12	10
A201	$01^h46.6^m$	+24°01.5′	1986 oct 29	23^h57^m	1	24	8
A205	$23^h05.0^m$	+18°39.8′	1986 oct 31	21^h41^m	2	25	19
A206	$01^h48.0^m$	+22°49.8′	1986 nov 1	00^h09^m	2.5	29	18
A208	$01^h26.6^m$	+22°49.2′	1986 nov 1	22^h36^m	1.5	4	6
A210	$00^h12.3^m$	+19°48.4′	1986 nov 2	20^h21^m	3	43	17

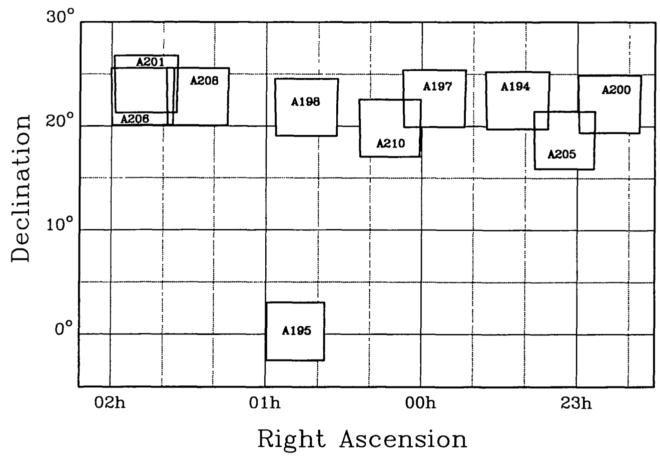

FIG. 1.—Schematic map of the sky showing the fields covered by the UCM Survey in the 1986 October campaign and included in the first list. Each plate covers a field of 5°5 × 5°5 deg². Field centers are provided in Table 1.

A study on the feasibility of automatic detection of ELGs using MAMA (Machine Automatique à Mesurer pour l'Astronomie; Guibert et al. 1991) has been started (Alonso et al. 1993).

3. OBJECT CLASSIFICATION

The procedure outlined yielded a list of candidates which were classified according to three parameters: the continuum intensity, contrast of emission line over the continuum, and the width of the spectrum perpendicular to the dispersion.

First in the classification scheme is the continuum estimate in three categories A, B, C in order of increasing strength relative to plate background. A candidate with marginally present or absent continuum is given an A; moderate continuum intensity objects are classified as B; finally, candidates with very strong, almost saturated continua are classified under the C category. Next in the classification is the estimate of the apparent equivalent width of the emission line. Candidates are given a 1, 2, or 3 according to the contrast with respect to the continuum on the plates. The number 1 signifies low-contrast emission line, scarcely visible over the continuum. Objects with number 2 present a marked emission line. An equivalent width parameter of 3 is reserved for objects which exhibit a very contrasted emission line, even saturated. Finally, we have used a concentration parameter which is based upon eye estimates of the widths of the spectra, perpendicular to the dispersion. Candidates for which the spectrum is clearly wider than stellar are denoted as "d" for diffuse. No intermediate categories have been used because of the subjective nature of these eye estimates.

The fields covered by plates A201 and A206 overlap in a wide region. As the observational parameters were similar, it is instructive to compare the results obtained on both cases. The plates were taken from the same batch, sensitized and processed with the standard procedure. Moreover, exposure times and airmasses were similar and guiding was excellent on both plates. However, plate A206 presents spectra with higher intensity, and it seems that candidates are more easily detected on this plate (15) than in A201 (9). Some cirrus could have been present during the observation of plate A201, although there was a transparent atmosphere when plate A200 was exposed at the beginning of this night. These weak clouds, which passed unnoticed to the observers during the dark night, probably produce a worse transparency. The good seeing conditions on A201 support this hypothesis. It is interesting to bear in mind that apparent better observational conditions, better seeing in this case, could lead to worse results. Plates A206 and A201 were searched independently for emission-line galaxies. Up to 9 of the 15 candidates found in A206 fall outside the area covered by A201. There are five candidates detected on both plates, and this leaves three undetected objects on A201: two very weak candidates and a spiral galaxy with H II regions which show faint emission lines on the spectra of A206. However, three bright spiral UGC galaxies, which show Hα emission on A201, were not selected on A206 due to saturation of their continua. Finally, UCM 0141+2220 was selected from its spectrum on A201 and was unnoticed on A206. This last problem is inherent to visual inspection of the plates which we wish to overcome using automatic scanning in the near future.

The B1950.0 coordinates of the survey objects were obtained from measurement using computer-generated overlay charts with the nearest SAO stars as reference for each object. Measures of stars and known galaxies show that the positions can be reproduced to 20″ by this procedure. Therefore, our cataloged coordinates have that precision for new objects (galaxies not previously cataloged). Coordinates of known galaxies are taken from the Catalogue of Principal Galaxies (PGC) (Paturel et al. 1989). Attempts to obtain the positions using a Coradograph X-Y measuring machine leads to systematic differences between the measured positions of the survey objects, which are usually very weak, and the reference stars, as pointed out by different authors (see, e.g., Pesch & Sanduleak 1983) since the red cutoff of the spectrum is very dependent of the color and magnitude of the object. Follow-up observations, both imaging and spectroscopy with large telescopes, of most of the candidates have shown that our coordinates are good enough to find the targets using the charts. When positions were inaccurate, new offset values were measured with these telescopes from the nearest SAO star in order to determine better coordinates.

Information about the objects of the first list of our survey is presented in Table 2. Column (1) contains the positional UCM designation. Names composed of the values of right ascension and declination are given according to IAU rules; UCM stands for Universidad Complutense de Madrid. Objects are arranged in order of increasing right ascension. Equatorial coordinates for B1950.0 are given in columns (2) and (3). Column (4) contains the object classification according to the three parameters scheme described before. In column (5) the blue magnitudes are listed for previously cataloged galaxies. In column (6) we give image dimensions (major diameter × minor diameter) in minutes of arc, roughly measured on the red images of the POSS prints for new objects and taken from PGC for cataloged galaxies. Candidates already confirmed as emission-line objects by ourselves have been labeled in column (7) with an asterisk; for active galaxies, column (7) contains their spectral classification. *IRAS* counterparts are given in column (8). Finally, in column (9) previous designations are listed. The abbreviations refer to the following catalogs or

TABLE 2

UCM SURVEY LIST I

UCM name (1)	RA(1950) (2)	DEC(1950) (3)	Type (4)	m (5)	size (6)	spectrum (7)	IRAS (8)	Other names (9)
0000+2140	00 00 35.6	+21 40 54	B3	14.3	1.0 x 0.7	Sy1.8	00005+2140	Z477.043 U00006 4ZW001 VV806 M+04-01-013 Z478.015 MK334 KUG0000+216
0001+2024	00 01 33.0	+20 24 00	B1		0.2 x 0.2			
0003+2200	00 03 03.9	+22 00 15	A1d	16.5	0.3 x 0.2			KUG0003+220
0003+2215	00 03 18.7	+22 15 32	B1	16.0	0.7 x 0.2		00033+2215	M+04-01-020 KAZ16
0003+1955	00 03 45.2	+19 55 29	C1	13.8	0.3 x 0.3	Sy1	00037+1955	KW31 VV101 A003+19 KUG003+199 MK335
0005+1802	00 05 54.0	+18 02 56	A1d		0.4 x 0.2			
0006+2332	00 06 20.1	+23 32 24	B1d	14.5	1.1 x 0.7		00063+2322	Z477.059 N0009 U00078 M+04-01-030 Z478.031
0009+2024	00 09 50.2	+20 24 14	A2		0.1 x 0.1			
0012+2109	00 12 30.6	+21 09 06	A1		0.1 x 0.1			
0013+1944	00 13 14.7	+19 44 00	A2d		0.2 x 0.1			
0014+1829	00 14 40.0	+18 29 32	A3		0.2 x 0.1	*		
0014+1748	00 14 48.7	+17 48 28	A3d	14.9	1.5 x 0.7	*	00148+1748	Z456.053 U00164 M+03-01-036
0015+2212	00 15 31.8	+22 12 06	A3	16.0	0.3 x 0.3	*		MK1141
0017+1942	00 17 22.0	+19 42 13	A2	15.7	0.3 x 0.2			Z457.004 KARA72004A Z456.059 M+3-02-002 ARAK7
0017+2148	00 17 50.0	+21 48 48	A2		0.2 x 0.1	*		
0018+2216	00 18 56.5	+22 16 11	A2d		0.2 x 0.2	*		
0018+2218	00 18 58.3	+22 18 53	A1d	14.9	0.8 x 0.3		00189+2218	Z479.011 N0084 M+04-02-010
0019+2201	00 19 13.0	+22 01 23	A2		0.3 x 0.1	*		
0019+2045	00 19 26.2	+20 45 22	A1		0.1 x 0.1			
0022+2049	00 22 07.2	+20 49 23	B3	15.5	0.4 x 0.2	*		Z457.013
0034+2120	00 34 06.1	+21 20 00	A1	15.6	0.5 x 0.3			Z457.021
0036+2007	00 36 33.8	+20 07 09	A2		0.2 x 0.2			
0037+2226	00 37 32.6	+22 26 32	A2d	14.6	0.6 x 0.5		00375+2226	Z479.056 U00425 IC0041
0038+0235	00 38 12.0	+02 35 00	A1d	15.8	0.9 x 0.2			Z383.067 M+00-02-122
0038+2259	00 38 30.8	+22 59 17	A1		0.2 x 0.2			
0038+2302	00 38 46.2	+23 02 09	A1		0.1 x 0.1			
0039+0054	00 39 10.0	+00 54 00	A1d	15.6	0.6 x 0.4	*		Z383.070 M+00-02-12
0040+0257	00 40 02.8	+02 57 55	A2	17.0	0.1 x 0.1	*		MK1144 UM061
0040+2312	00 40 08.3	+23 12 55	A1d	15.8	0.7 x 0.2		00401+2313	Z479.061 M+04-02-047
0040+0220	00 40 15.5	+02 20 23	A2	17.0	0.2 x 0.2	*		UM063
0040−0023	00 40 53.9	−00 23 56	C1d	13.6	1.6 x 0.9	*	00408-0023	U00461 N0237
0041+0135	00 41 21.9	+01 34 28	A1d	14.2	1.5 x 1.3	*		Z384.003 U00468 IC0049 M+00-03-003
0043+0245	00 43 09.9	+02 45 25	B1	17.0	0.2 x 0.1	*		UM064
0043+2440	00 43 27.7	+24 40 43	A2d		0.2 x 0.3			
0043−0159	00 43 32.2	−01 59 43	B1d	13.1	1.3 x 1.3	*	00435−0159	Z384.004 MK555 UM274 U00476 N00245 M+00-03-005
0044+2246	00 44 42.0	+22 46 26	A2d	16.9	0.6 x 0.2			M+04-03-003
0045+2256	00 45 05.6	+22 56 26	A1		0.1 x 0.1			
0045−0157	00 45 12.6	−01 57 00	A1		0.3 x 0.3			
0045+2206	00 45 17.0	+22 06 06	B2d	14.9	0.3 x 0.3	*	00452+2205	Z480.006 IC1586 3ZW012 MK347
0047+2051	00 47 12.3	+20 51 19	A1		0.2 x 0.2		00472+2051	
0047+2413	00 47 32.0	+24 13 23	B1	15.5	0.6 x 0.5	*		Z480.013 M+04-03-011
0047−0213	00 47 32.1	−02 13 24	B2	15.5	0.3 x 0.2	*		Z384.012 UM280
0047+2414	00 47 45.3	+24 14 35	B1d	15.2	0.4 x 0.3	*	00477+2414	Z480.014 M+04-03-012 ARAK15
0049−0006	00 49 13.6	−00 06 37	A3	18.0	0.1 x 0.1	*		UM282
0049+0017	00 49 15.6	+00 17 37	A2	17.0	0.3 x 0.2	*		UM283

TABLE 2—*Continued*

UCM name (1)	RA(1950) (2)	DEC(1950) (3)	Type (4)	m (5)	size (6)	spectrum (7)	IRAS (8)	Other names (9)
0049−0045	00 49 26.1	−00 45 29	B1	15.3	0.4 x 0.2	*		Z384.016 UM286 M+00-03-018 ARAK18
0049+0013	00 49 50.3	+00 13 24	A1		0.1 x 0.1			
0050+0005	00 50 24.1	+00 05 52	A2	16.0	0.3 x 0.2	*		UM290
0050+2114	00 50 54.0	+21 14 27	B3	14.5	0.3 x 0.2	*	00509+2114	MK349
0051+2430	00 51 14.6	+24 30 01	B2	15.1	1.4 x 0.4		00512+2430	Z480.019 U00547 M+04-03-015
0053+2352	00 53 12.1	+23 52 00	B1	15.5	0.7 x 0.3			Z480.021 4ZW34 M+04-03-017
0053−0049	00 53 14.9	−00 49 15	B1	16.0	0.2 x 0.1			UM292
0054−0133	00 54 05.7	−01 33 56	A1d	15.5	0.5 x 0.2	*	00540−0133	Z384.040
0054+2337	00 54 38.9	+23 37 07	A2	15.1	0.9 x 0.6	*		Z480.025 U00591 M+04-03-023 MK350
0056+0044	00 56 21.5	+00 44 10	A3	17.0	0.3 x 0.2	*		UM295
0056+0043	00 56 30.1	+00 43 54	A2	16.6	0.3 x 0.2	*		UM296
0119+2156	01 19 01.3	+21 56 55	A1d		0.6 x 0.2		01196+2156	
0121+2137	01 21 54.0	+21 37 00	A1d	15.7	0.7 x 0.6		01203+2154	Z481.007
0129+2109	01 29 32.9	+21 09 16	B1d	14.8	0.9 x 0.5		01295+2109	Z460.004 U01098 M+3-05-004 Z459.078
0130+2505	01 30 34.7	+25 05 51	A2		0.1 x 0.1			
0134+2258	01 34 25.9	+22 58 01	A1d	17.0	0.4 x 0.3		01344+2258	M+04-04-015
0135+2242	01 35 13.9	+22 42 09	A2		0.2 x 0.2	*		
0138+2016	01 38 01.0	+20 16 02	A3		0.2 x 0.2			
0138+2047	01 38 15.0	+20 47 36	A1		0.2 x 0.2			
0138+2216	01 38 16.8	+22 16 45	A1		0.2 x 0.1		01382+2216	
0139+2226	01 39 10.8	+22 26 13	A1	15.5	1.0 x 0.5			Z482.002 U01188
0141+2220	01 41 32.3	+22 20 00	A2		0.2 x 0.4			
0142+2137	01 42 04.0	+21 37 40	A2d	15.2	0.8 x 0.4		01421+2138	Z482.008 M+04-05-004
0142+2441	01 42 24.6	+24 41 17	A1		0.2 x 0.2		01424+2441	
0145+2519	01 45 00.0	+25 19 33	A1d	15.2	0.7 x 0.4		01450+2519	Z482.015 M+04-05-010
0147+2309	01 47 55.4	+23 09 10	A2		0.3 x 0.2	*		
0148+2124	01 48 20.4	+21 24 03	A2		0.2 x 0.1	*		
0150+2032	01 50 57.2	+20 32 40	A2d		0.4 x 0.1	*		
0150+2056	01 50 59.9	+20 56 36	B1		0.4 x 0.2			
0152+2039	01 52 04.6	+20 39 04	A1		0.1 x 0.1			
0155+2507	01 55 40.8	+25 07 00	B2d	14.3	1.2 x 0.6		01556+2507	Z482.032 U01451 M+04-05-024
0155+2223	01 55 42.6	+22 23 36	A2		0.2 x 0.2	*		
0156+2410	01 56 27.2	+24 10 43	A2d	14.8	0.6 x 0.3	*		Z482.035
0157+2324	01 57 06.5	+23 24 06	B1d	13.3	1.7 x 1.7		01570+2323	Z482.037 U01471 N0776 M+04-05-028
0157+2413	01 57 30.0	+24 13 55	B1d	14.9	1.0 x 0.3		01574+2323	Z482.043 U01479 M+04-05-034
0157+2102	01 57 45.2	+21 02 45	B1	14.3	0.5 x 0.2		01577+2102	Z461.023 U01490
0158+2354	01 58 59.9	+23 54 40	A2		0.2 x 0.1	*		
0159+2327	01 59 01.0	+23 27 20	B2d	15.5	0.4 x 03	*		Z482.050
2238+2308	22 38 50.3	+23 08 18	A1d	14.7	0.8 x 0.8	*	22388+2308	Z474.020 U12148 IC5242 M+04-53-010 KUG2238+231
2239+2402	22 39 06.7	+24 02 28	A1		0.1 x 0.1			
2239+1959	22 39 30.5	+19 59 59	B3	14.9		Sy2	22395+2000	Z452.043 M+03-57-031 MK308 KUG2239+199
2241+2431	22 41 02.3	+24 31 26	A2		0.1 x 0.1			
2244+2049	22 44 06.0	+20 49 11	A1d	14.9	0.8 x 0.6			Z453.007 M+03-58-003 N7375
2249+2149	22 49 32.3	+21 49 03	A1		0.4 x 0.1			
2250+2427	22 50 09.9	+24 27 54	A1	15.4	0.6 x 0.3	*	22501+2427	Z475.001 4ZW121 KARA993 KUG2250+244 MK309
2251+2352	22 51 20.0	+23 52 09	A2		0.2 x 0.2	*		
2251+2405	22 51 53.9	+24 05 07	A1		0.1 x 0.1			

TABLE 2—*Continued*

UCM name (1)	RA(1950) (2)	DEC(1950) (3)	Type (4)	m (5)	size (6)	spectrum (7)	IRAS (8)	Other names (9)
2253+2219	22 53 04.6	+22 19 32	A1		0.4 x 0.2	*		KUG2253+223
2253+2453	22 53 17.9	+24 53 17	A1		0.1 x 0.1			
2255+1930S	22 55 07.6	+19 30 55	B2	14.5	0.2 x 0.1	*	22551+1931	Z453.031 U12265
2255+1930N	22 55 07.6	+19 30 55	B2d		0.7 x 0.5	*		
2255+1926	22 55 18.0	+19 26 20	A1		0.3 x 0.1	*		
2255+1654	22 55 25.7	+16 54 03	A1d		1.0 x 0.2	*	22554+1654	
2256+2002	22 56 18.0	+20 02 00	A2	15.2	0.9 x 0.7	*		Z453.036 U12278 M+03-58-016
2257+2438	22 57 07.5	+24 38 59	A3	16.8	0.2 x 0.2	Sy1		KAZ320
2257+1606	22 57 50.5	+16 06 51	B1	17.0	0.2 x 0.2	Sy2		MK522 KUG2257+161
2258+1920	22 58 39.0	+19 20 32	B2d	15.2	0.4 x 0.3	*		Z453.046
2300+2014	23 00 48.3	+20 14 49	A2		0.3 x 0.3	*	23008+2014	
2302+2053	23 02 54.0	+20 53 25	A3		0.1 x 0.1	*		
2303+2053	23 02 59.5	+20 53 33	C1d	15.0	0.9 x 0.7	*		Z453.065
2303+1856	23 03 07.2	+18 56 19	B2	15.7	0.3 x 0.2			Z453.067
2303+1702	23 03 27.0	+17 02 06	A3		0.2 x 0.2	Sy2		
2304+1640	23 04 27.0	+16 40 00	A2		0.1 x 0.1	*		
2305+1621	23 05 00.0	+16 21 27	A2		0.1 x 0.1	*		
2306+1703	23 06 17.0	+17 03 04	A1d		0.9 x 0.2			
2306+1947	23 06 48.0	+19 47 21	A2d	15.8	0.2 x 0.1	*		Z454.001 KARA1007
2307+2118	23 07 23.1	+21 18 34	B2		0.1 x 0.1	*		
2310+1800	23 10 09.1	+18 00 14	A1		0.3 x 0.2		23101+1800	
2312+2204	23 12 20.1	+22 04 18	A1		0.2 x 0.1			
2312+2500	23 12 43.7	+25 00 40	B1	14.4	1.1 x 0.9	*	23127+2459	Z475.050 U12455 N7548 M+04-54-036
2313+1842	23 13 09.0	+18 42 09	A2		0.2 x 0.1	*		
2313+2516	23 13 31.2	+25 16 48	B1	15.0	0.7 x 0.7	*	23135+2516	Z475.056 IC5298 M+04-54-038
2315+1923	23 15 31.6	+19 23 11	A2		0.2 x 0.1	*		
2315+1658	23 15 44.6	+16 58 26	A3			*		
2316+2457	23 16 10.3	+24 57 27	B1	14.1	1.0 x 0.8	*	23161+2457	Z475.060 U12490 M+04-55-001 Z476.001 MK319 KUG2316+249
2316+2459	23 16 12.2	+24 59 49	A2	15.7	0.4 x 0.3	*		Z475.061 Z476.002
2316+2028	23 16 58.7	+20 28 23	A2		0.4 x 0.3	*	23170+2028	
2317+2356	23 17 36.9	+23 56 47	B1	13.6	1.2 x 1.1	*	23176+2356	Z476.008 U12520 N7620 MK321 KUG2317+239
2319+2234	23 19 50.0	+22 34 18	A2		0.2 x 0.1			KUG2319+225
2319+2243	23 19 50.5	+22 43 38	B1		0.7 x 0.2	*		
2320+2036	23 20 34.8	+20 36 19	B2		0.1 x 0.1			
2320+2428	23 20 54.0	+24 28 42	B1	15.7	0.7 x 0.2	*	23209+2428	Z476.027 KAZ332
2321+2149	23 21 38.5	+21 49 45	A1d		0.4 x 0.4	*		
2321+2506	23 21 57.3	+25 06 34	A1	15.1	0.6 x 0.3	*		Z476.030 KUG2321+251
2322+2204	23 22 33.4	+22 04 11	A1		0.1 x 0.1			
2322+2218	23 22 55.2	+22 18 32	A2		0.2 x 0.1	*		
2323+2047	23 23 13.8	+20 47 34	A1d		0.4 x 0.2	*		
2323+2252	23 23 54.7	+22 52 09	A1		0.1 x 0.1			
2324+2448	23 24 10.2	+24 48 18	B1	13.4	2.6 x 1.5	*	23241+2448	Z476.038 U12598 N7664 M+04-55-013 KARA1019
2325+2318	23 25 12.0	+23 18 52	B2	13.2	1.3 x 1.2	*	23252+2318	Z476.042 U12607 N7673 M+04-55-014 MK325 4ZW149 VV619 KUG2325+233
2325+2208	23 25 58.2	+22 08 50	B2	12.5	2.5 x 1.7	*	23259+2208	Z476.045 U12614 N7678 ARP028 KUG2325+221 KAZ336
2326+2435	23 26 18.8	+24 35 59	A3		0.4 x 0.1	*		
2327+2154	23 27 37.2	+21 54 51	A1		0.2 x 0.2			

TABLE 2—*Continued*

UCM name (1)	RA(1950) (2)	DEC(1950) (3)	Type (4)	m (5)	size (6)	spectrum (7)	IRAS (8)	Other names (9)
2327+2515	23 27 40.0	+25 15 19	B2	15.0	0.3 x 0.2	*	23276+2515	Z476.055 A2327+25 3ZW107 4ZW153
2327+1956	23 27 59.6	+19 56 46	A1d	15.5	0.3 x 0.3			
2328+2109	23 28 27.7	+21 09 46	B1d	15.7	0.2 x 0.1			Z455.003 Z454.079
2329+2447	23 29 08.4	+24 47 56	A1		0.3 x 0.3			
2329+2427	23 29 18.0	+24 27 33	B1	15.7	0.4 x 0.1			Z476.060
2329+2500	23 29 25.3	+25 00 59	B2	15.6	0.2 x 0.2	Sy1		KAZ341
2329+2511	23 29 34.9	+25 11 53	A1		0.2 x 0.2	*		
2331+2214	23 31 49.9	+22 14 12	A1		0.2 x 0.2	*		
2333+2248	23 33 02.6	+22 48 27	A2d		0.2 x 0.1	*		
2333+2241	23 33 17.7	+22 41 26	B1		0.9 x 0.2			
2333+2359	23 33 35.4	+23 59 43	B2		0.2 x 0.2	Sy		
2334+2134	23 34 09.5	+21 34 48	A1		0.1 x 0.1			
2344+2157	23 44 29.0	+21 57 10	A1		0.1 x 0.1			
2346+2011	23 46 49.2	+20 11 26	A1		0.2 x 0.2			
2348+2407	23 48 52.3	+24 07 51	A2		0.3 x 0.2			
2351+2321	23 51 17.7	+23 21 26	A2		0.2 x 0.2	*		
2352+2040	23 52 03.0	+20 40 43	A1		0.1 x 0.1			
2352+2230	23 52 29.2	+22 30 00	B1		0.1 x 0.1			
2353+2027	23 53 22.0	+20 27 09	A1		0.1 x 0.1			
2354+2232	23 54 00.0	+22 32 06	A1		0.2 x 0.2			
2357+2440	23 57 09.4	+24 40 00	B1		0.1 x 0.1			
2357+2241	23 57 12.0	+22 41 58	B1		0.2 x 0.2			

NOTES TO TABLE 2

UCM0000+2140 spiral with asymmetrical arm structure; perculiarly distorted.

UCM0001+2024 elongated E-W; compact.

UCM0003+2200 elongated E-W; compact.

UCM0003+2215 very elongated N-S; diffuse

UCM0003+1955 spherical compact. Seyfert 1.

UCM0005+1802 edge-on spiral.

UCM0006+2332 spheroidal bulge surrounded by annular structure; the emission arises from the bulge.

UCM0009+2024 stellar-like appearance.

UCM0012+2109 stellar-like appearance.

UCM0013+1944 bright oval with appendix protruding northward and only apparent in POSS blue plates; 30 arcsec eastward of Z456.050.

UCM0014+1829 bright field star eastward of the galaxy prevents classification.

UCM0014+1748 barred spiral; the emission arises from the nucleus.

UCM0015+2212 spheroidal compact.

UCM0017+1942 galaxy probably distorted by northern companion U00188. A field star is attached at the west side.

UCM0017+2148 elongated compact.

UCM0018+2216 spheroidal compact; eastward of N0086.

UCM0018+2218 spiral; northward of N0086.

UCM0019+2201 elongated; eastward of Z479.012.

UCM0019+2045 stellar-like appearance.

UCM0022+2049 ellipsoidal.

UCM0034+2120 clumpy irregular.

UCM0036+2007 compact but somewhat oval in shape; in Zwicky cluster ZC0036.1+2035

UCM0037+2226 diffuse spheroidal.

UCM0038+0235 edge-on spiral.

UCM0038+2259 stellar-like appearance object between two galaxies.

UCM0038+2302 stellar-like appearance.

UCM0039+0054 spiral with prominent external HII region.

UCM0040+0257 compact; west component of pair.

UCM0040+2312 barred spiral in rich field of galaxies.

UCM0040+0220 compact spheroidal.

UCM0040-0023 barred spiral with HII regions.

UCM0041+0135 outer HII region in nearby spiral.

UCM0043+0245 diffuse oval.

UCM0043+2440 spiral almost face-on.

UCM0043-0159 nearby spiral with several HII regions.

UCM0044+2246 elongated; eastward of IC1585.

UCM0045+2256 stellar-like appearance.

UCM0045-0157 spheroidal compact.

UCM0045+2206 spheroidal compact.

UCM0047+2051 spheroidal compact.

UCM0047+2413 barred spiral.

UCM0047-0213 diffuse oval.

UCM0047+2414 compact oval.

UCM0049-0006 stellar-like appearance.

UCM0049+0017 spiral.

UCM0049-0045 oval.

UCM0049+0013 stellar-like appearance.

UCM0050+0005 compact oval.

UCM0050+2114 spiral with apparent close companion.

UCM0051+2430 lenticular in triple system.

UCM0053+2352 spiral almost edge-on.

UCM0053-0049 oval.

UCM0054-0133 spiral.

UCM0056+0044 diffuse irregular.

UCM0056+0043 oval.

UCM0119+2156 edge-on spiral with prominent nucleus.

UCM0121+2137 irregular, distorted, with several knots; two smaller galaxies in the neighborhood.

UCM0129+2109 barred spiral.

UCM0130+2505 stellar-like appearance.

UCM0134+2258 spiral.

UCM0135+2242 compact.

UCM0138+2016 stellar-like appearance.

UCM0138+2047 compact.

UCM0138+2216 oval.

UCM0139+2226 spiral.

UCM0141+2220 spiral.

UCM0142+2137 barred spiral.

UCM0142+2441 face-on spiral.

UCM0145+2519 barred spiral with ring.

UCM0147+2309 spiral.

UCM0148+2124 diffuse compact.

UCM0150+2032 spiral almost edge-on.

UCM0150+2056 elliptical shape.

UCM0152+2039 stellar-like appearance; near a very bright star.

UCM0155+2507 barred spiral with bright nucleus.

UCM0155+2223 compact oval.

UCM0156+2410 spiral.

NOTES TO TABLE 2—*Continued*

UCM0157+2324 barred spiral with two prominent HII regions.

UCM0157+2413 edge-on spiral with field star at north-east.

UCM0157+2102 spiral.

UCM0158+2354 compact oval.

UCM0159+2327 compact elliptical.

UCM2238+2308 face-on spiral with field star at north.

UCM2239+2402 stellar-like appearance.

UCM2239+1959 spiral.

UCM2241+2431 stellar-like appearance with NW companion, possible star.

UCM2244+2049 spiral with ring.

UCM2249+2149 spiral.

UCM2250+2427 distorted spiral.

UCM2251+2352 compact.

UCM2251+2405 stellar-like appearance.

UCM2253+2219 oval.

UCM2253+2453 stellar like in close pair.

UCM2255+1930S compact oval.

UCM2255+1930N spiral with halo.

UCM2255+1926 diffuse spiral.

UCM2255+1654 almost edge-on spiral.

UCM2256+2002 nearly spherical.

UCM2257+2438 spiral, Zamorano et al (1992a).

UCM2258+1920 compact oval. Emission comes from two regions located in the E-W direction.

UCM2300+2014 compact spherical.

UCM2302+2053 stellar like, westward of Z453.065.

UCM2303+2053 spiral almost face on.

UCM2303+1856 distorted spiral.

UCM2303+1702 spiral almost face on, Rego et al (1994).

UCM2304+1640 diffuse oval.

UCM2305+1621 spherical with halo.

UCM2306+1703 elongated with bright knot at West.

UCM2306+1947 elongated.

UCM2307+2118 compact spherical.

UCM2310+1800 spheroidal.

UCM2312+2204 oval with condensed core.

UCM2312+2500 barred lenticular.

UCM2313+1842 oval with stellar companion at NW.

UCM2313+2516 spiral.

UCM2315+1923 diffuse oval.

UCM2315+1658 Does not appear neither in the red nor in the blue POSS plate. A CCD image shows a stellar-like appearance object with magnitude Gunn-Thuan r=20.1, halfway between two stars.

UCM2316+2457 barred spiral.

UCM2316+2459 nearby spiral.

UCM2316+2028 oval.

UCM2317+2356 HII region in face on nearby spiral.

UCM2319+2234 elongated compact with spheroidal at SW.

UCM2319+2243 diffuse oval.

UCM2320+2036 stellar like.

UCM2320+2428 edge on spiral with a field star in the foreground.

UCM2321+2149 almost spherical.

UCM2321+2506 ellipsoidal, with field star at SW.

UCM2322+2204 stellar-like appearance.

UCM2322+2218 diffuse elongated, not symmetrical.

UCM2323+2047 barred spiral with stellar object at NW.

UCM2323+2252 stellar-like appearance.

UCM2324+2448 nearby espiral.

UCM2325+2318 very bright and compact galaxy; the emission comes from an external region.

UCM2325+2208 barred spiral, the emission comes from five external HII regions.

UCM2326+2435 asymmetrical spiral.

UCM2327+2154 diffuse spherical.

UCM2327+2515 two spiral galaxies and a field star aligned in the NS direction.

UCM2327+1956 diffuse spherical.

UCM2328+2109 ellipsoidal with protruding extension in the NW.

UCM2329+2447 face-on spiral.

UCM2329+2427 spiral with condensed nucleus.

UCM2329+2500 highly condensed nucleus surrounded by an extended halo.

UCM2329+2511 distorted spiral.

UCM2331+2214 two condensations embedded in an oval envelope.

UCM2333+2248 elongated with two condensations.

UCM2333+2241 edge-on spiral with prominent buldge.

UCM2333+2359 spheroidal with two companions.

UCM2334+2134 east component of pair of stellar-like appearance objects.

UCM2344+2157 west component of pair.

UCM2346+2011 stellar-like appearance.

UCM2348+2407 oval with extension to the South.

UCM2351+2321 diffuse spheroidal.

UCM2352+2040 stellar-like appearance.

UCM2352+2230 spheroidal.

UCM2353+2027 stellar-like appearance.

UCM2354+2232 stellar-like appearance.

UCM2357+2440 stellar-like appearance.

UCM2357+2241 stellar-like appearance.

surveys: N = NGC (Dreyer 1888), IC = Dreyer (1910), MK = Markarian (Markarian 1967; Markarian et al. 1981, and references therein), U = UGC (Nilson 1973), Z = Zwicky (Zwicky et al. 1963; Zwicky 1971), WAS = Wasilewski (1983), KARA = Karachentsev (1972), KAZ = Kazarian (Kazarian et al. 1980), KUG = Kiso (Takase et al. 1991, and references therein), M = MCG (Vorontsov-Velyaminov et al. 1974, and references therein), ARAK = Arakelian (1975), ARP = Arp (1966). A brief description of the appearance of the objects in the POSS prints and some additional information are given in the notes to the table.

A comprehensive literature search has been made in order to check whether the candidates are objects not previously cataloged and to obtain previous designations for our survey objects. We have used the master list compiled by Dixon & Sonnenborn (1980) and the Catalogue of Principal Galaxies (Paturel et al. 1989). Other lists have been also consulted such as the Case, University of Michigan, Kiso, and *IRAS* surveys.

We include identification charts for the new objects found in the survey in Figure 2 (Plates 11–14). The brighter known galaxies can be identified in the POSS plates by using the overlay maps provided by Dixon et al. (1981). Other objects can be found with the charts provided by the original discovery papers. Maps were copied from the POSS red prints.

Follow-up photometric observations have been started using the CCD camera of the 2.2 m telescope at Calar Alto Observatory. Images of 67% of the sample have been taken in the Gunn-Thuan r filter. A correlation between the visual estimated continuum parameter and the measured r magnitude of the objects has been found as expected. Objects belonging to the A category have apparent r magnitudes ranging from 15 to 17 peaking in r = 16. The B category includes objects with magnitudes in the range 14–16 and has its maximum in r = 14.5. Finally, the brightest objects, classified as C, have r magnitude around r = 14.5 and are all known galaxies. However, since the strength of the continuum is very dependent on the size and compactness of the galaxy and only three visual categories have been used, no direct relationship could be found between the continuum parameter and r magnitude.

The line-width estimate is also expected to be correlated with the actual values of the equivalent width of the Hα emission line. The emission line detected on the spectra of the selected candidates is a combination of Hα and the [N II] $\lambda\lambda$6548,6584 Å lines which are blended at the low dispersion of our survey. A preliminary analysis of the spectroscopic data available for 52% of the sample yields a value for the equivalent width of the blend lower than 100 Å for objects labeled with 1 and up to 550 Å for objects labeled with 3, but we cannot draw any conclusion before a comprehensive spectroscopic study of the sample is finished. These observations have allowed us to confirm the goodness of the visual selection (Rego et al. 1989; Zamorano et al. 1990) and revealed several especially interesting objects (Zamorano et al. 1992a,b; Rego et al. 1994; Gallego et al. 1993).

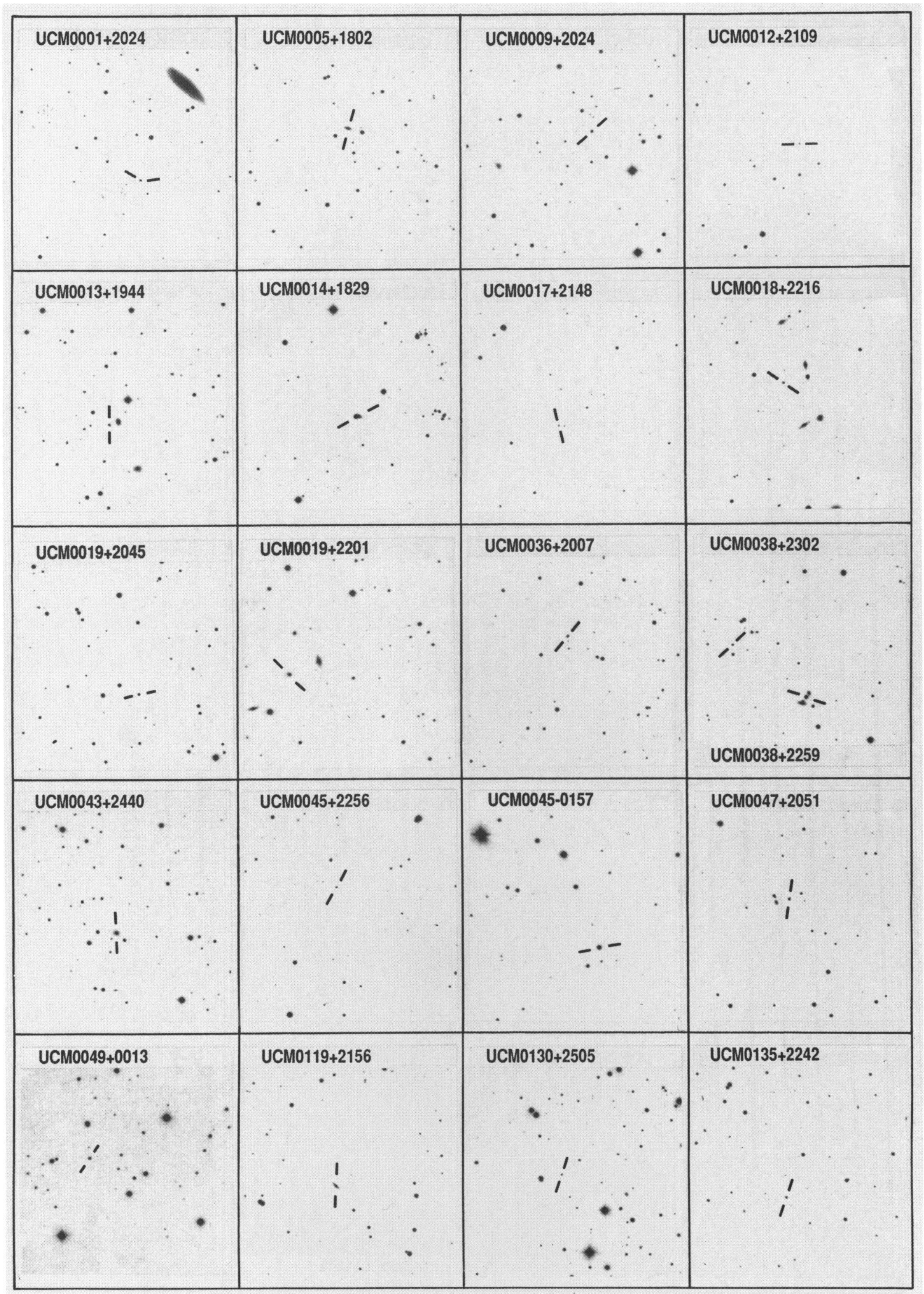

FIG. 2.—Finding charts for the new objects found in the survey. North is up and East to the left. Each field covers a square 10'.4 wide. Maps have been copied from the Palomar Observatory Sky Survey red prints.

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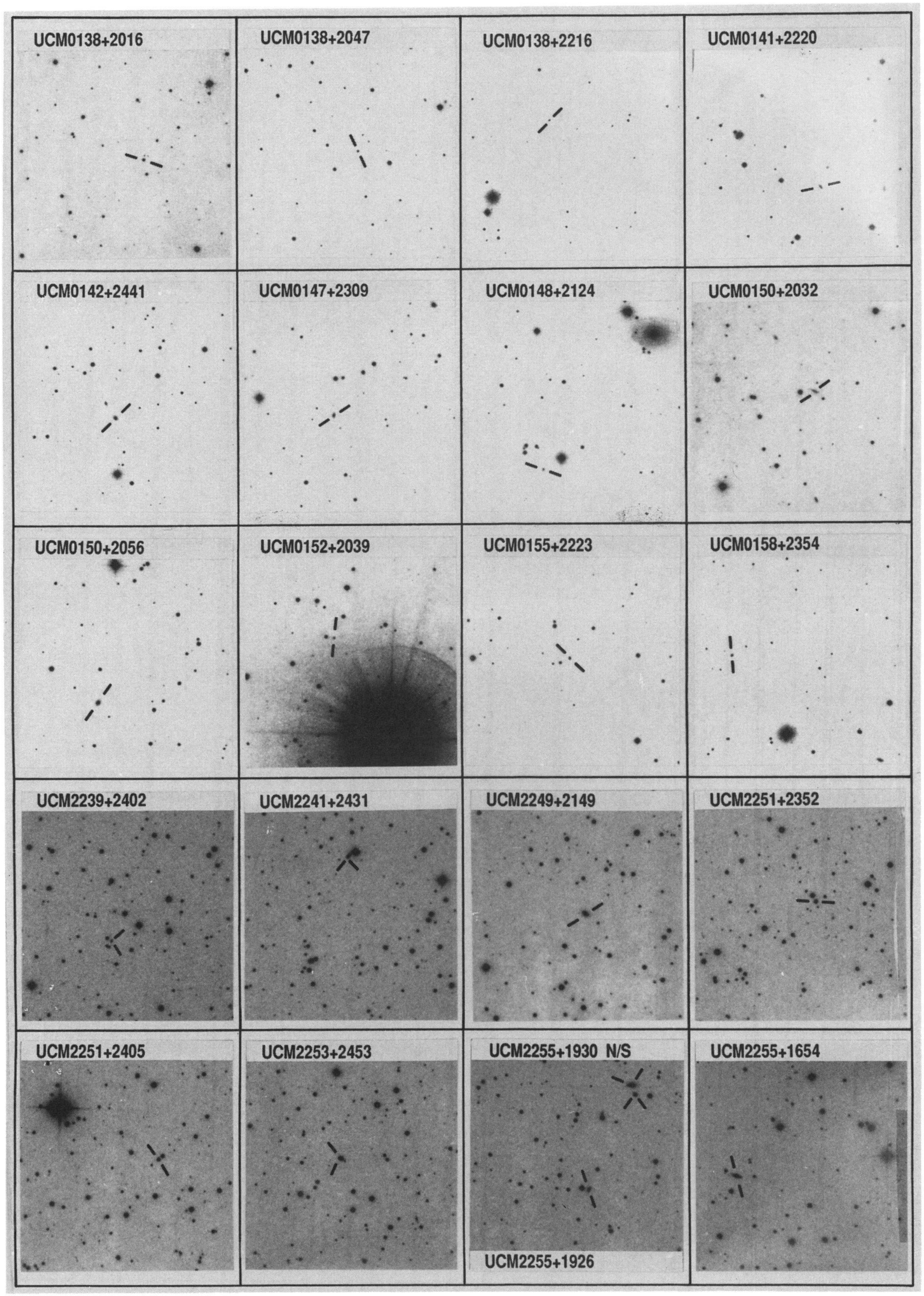

FIG. 2—*Continued*

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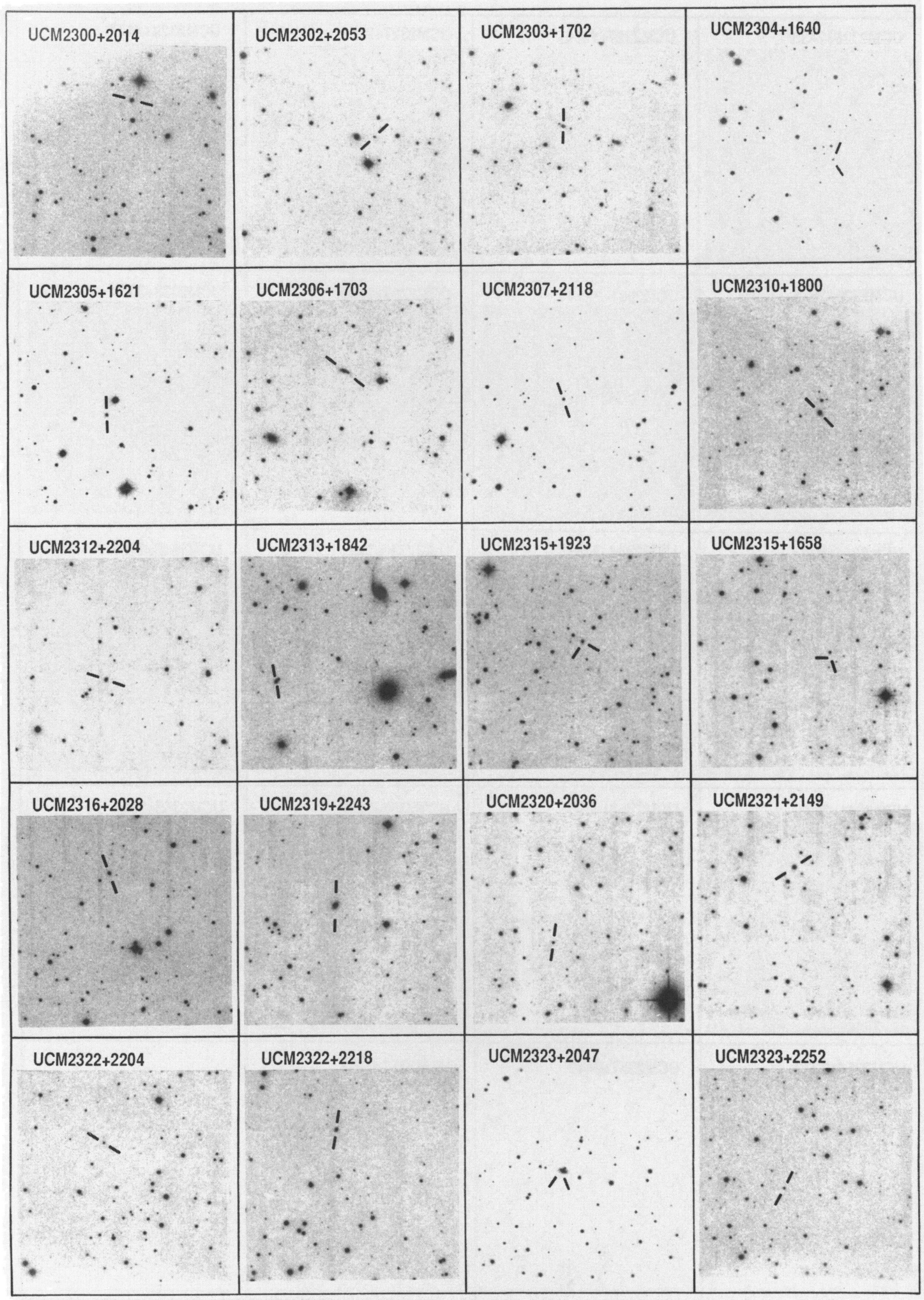

FIG. 2—*Continued*

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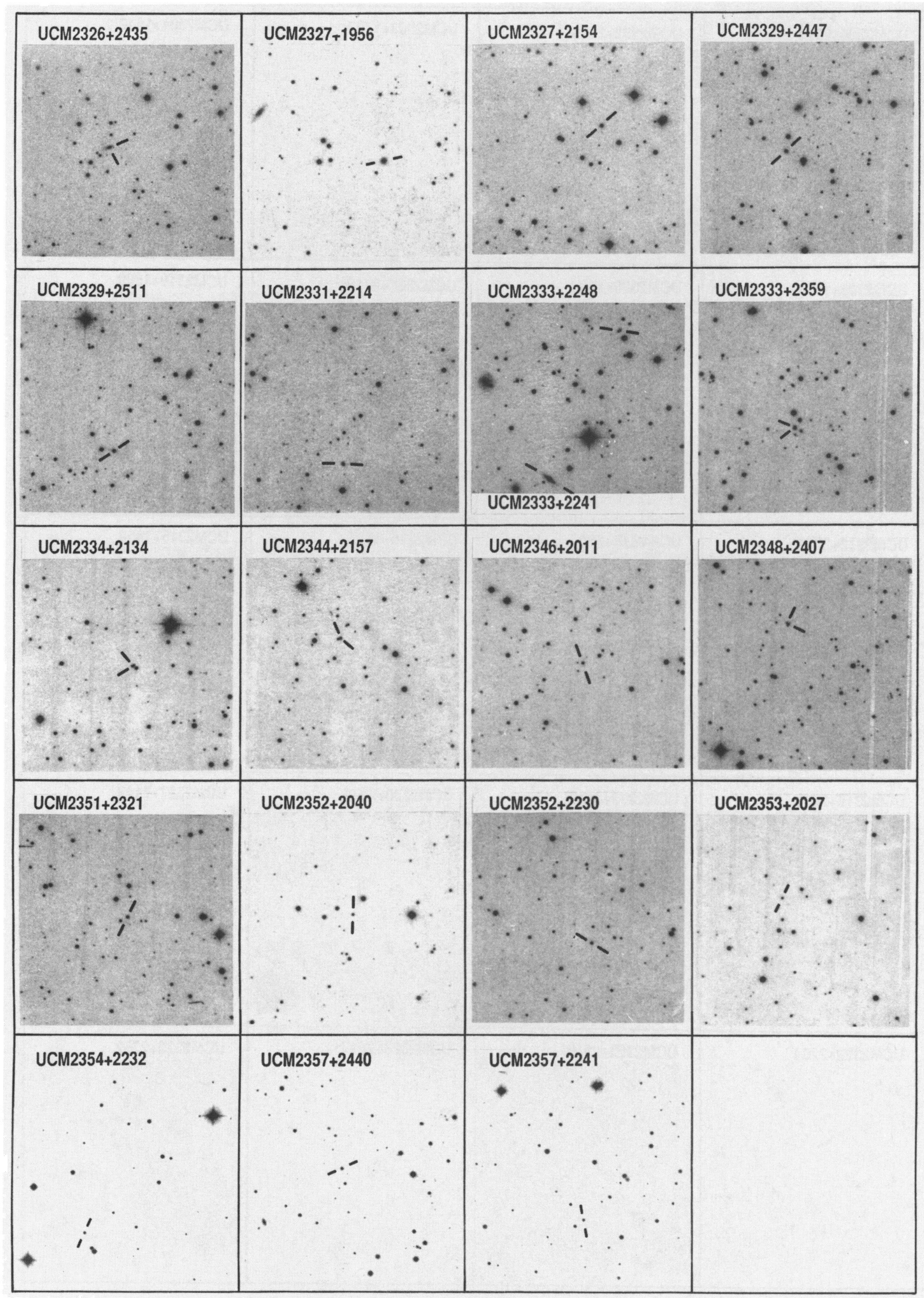

FIG. 2—*Continued*

ZAMORANO ET AL. (see 95, 395)

4. COMPARISON WITH OTHER SURVEYS

An important objective of our survey is to address the problem of the differences between the samples obtained with surveys in Hα and the ones selected with other techniques. Pesch & Sanduleak (1983) observed the fields of the Case low-dispersion Northern Sky Survey also on unfiltered IIIaF plates using a 4°.5 prism and dispersion around 2000 Å mm^{-1} at Hα, at the beginning of their survey, in a procedure very similar to ours. These authors noted a redundancy in this procedure and discontinued the IIIaF coverage in order to gain observing time and provide accelerated areal coverage on the IIIaJ plates. Most of the ELGs detected on the IIIaF plates by Pesch & Sanduleak were independently noted on the IIIaJ plates of their survey, either from their line emission or from their bluish continua. However, Markarian et al. (1987), from their experience with the Second Byurakan Survey, claim that surveys which do not use the Hα region for selecting ELGs miss a significant fraction of objects, mainly low-excitation ones.

The UCM Survey has found 160 candidates in 10 fields covered (270 deg^2). The overall density (candidates per square degree) is around 0.6, that is, six times that of the Markarian Survey. Nearly half of the sample (71 candidates, i.e., 45% of the sample) are galaxies which do not appear in any published catalog. The Catalogue of Principal Galaxies (PGC) (Paturel et al. 1989) lists 293 galaxies for the same fields. If galaxies with known redshift exceeding our survey limit $z = 0.04$ are discarded, this number reduces to 245. The Catalogue of Galaxies and of Clusters of Galaxies (Zwicky & Herzog 1963) contains 182 galaxies in the same area, 163 of which are galaxies with known redshift lower than $z = 0.04$. Only 56 candidates (35% of the sample) are galaxies cataloged by Zwicky.

Although a comparison of the observational selection effects must await the acquisition of more fields and the completion of follow-up spectroscopic observations, some conclusions can be extracted from the analysis of the samples selected by different surveys in the same area of the sky. Kinman (1984b) recommends observing a field centered in POSS field $\alpha = 0^h50^m$ and $\delta = 0°$ which has been covered by different surveys. We have taken a plate (A195) in this field and 19 candidates have been selected. The PGC lists 81 galaxies in this region, 27 of which have $z > 0.04$.

Kinman (1984a) found over 0.5 candidates per deg^2, a value in accordance with the one derived by us. It would be very interesting to compare both surveys, but Kinman's lists are not published yet and that prevents us from carrying a detailed analysis of differences. It should be noted that the Kinman Survey is based on plates taken with a dispersion of 400 Å mm^{-1} in Hα, that is, the spectra are 5 times more dispersed than the ones obtained by us. According to Kinman, at higher dispersions, the emission-line visibility improves as the continuum is spread out although the limiting magnitude of the continuum brightens. From a sample of Zwicky galaxies in a 70 deg^2 field near NGC 1023, Kinman (1984a) derives a ratio of galaxies with emission to the total number of 24%, and the UCM Survey finds that 34% of the Zwicky galaxies in the 270 deg^2 surveyed are ELGs. Most of the nearby and brighter galaxies which show emission because their individual H II regions are resolved and bright enough are detected by the Kinman Survey (64% of galaxies with $m_z < 14.0$) but only a small fraction of fainter galaxies (12% for $m_z > 15.0$). On the contrary the UCM Survey fails to detect bright galaxies (16% for $m_z < 14.0$), because their continua appear overexposed, but the fraction of fainter galaxies found with emission is considerably higher (41% for $m_z > 15.0$). The fraction for galaxies in the magnitude range 14.0–14.9 is similar for both surveys (around 36%). This result is illustrated in Figure 3 where the numbers and fractions of ELGs for each magnitude interval are represented. We conclude that our survey is biased towards less luminous galaxies with respect to the survey of Kinman.

The survey of Wamsteker et al. (1985) was also carried out at Hα with a dispersion of 1500 Å mm^{-1} and using IIIaF+RG630 plate-filter combination. The list of faint southern galaxies with Hα emission contains 113 galaxies. On their four plates which form a more or less homogeneous set of good quality, they found an average of 0.4 galaxies per deg^2. Only 42 of their candidates (37%) were galaxies listed on the ESO/Uppsala Survey of the ESO(B) Atlas (Lauberts 1982). After observing a small number of these galaxies they concluded that the objects found cover a wide variety of types and that a number of low-ionization H II regions would not be found by other methods. Some of their galaxies showed spectra similar to those of *IRAS* galaxies (Prieto et al. 1986).

The University of Michigan Survey found 39 objects in the same area (MacAlpine et al. 1977a, UM List I; MacAlpine et al. 1977, UM List III). There are 12 objects which have been selected both by UM and UCM surveys. The difference in survey techniques is shown by the degree of confidence in the detection of UM 296 (UCM 0056+0043): while MacAlpine et al. (1977) comment on the uncertainty of the emission, we classify its objective-prism (OP) spectrum as A2, that is, marked emission line; the equivalent width of the Hα line of this galaxy is EW(Hα+[N II]) = 71 Å as measured by us. Most

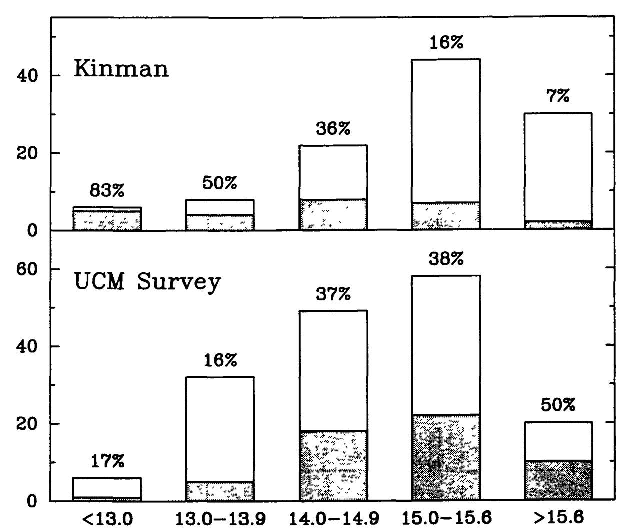

FIG. 3.—Fraction of Zwicky galaxies found with emission by the survey of Kinman (1984a) from a 30 deg^2 field near NGC 1023 and by this work (270 deg^2). Shaded areas represent the ELGs found for each Zwicky magnitude interval. The Kinman Survey detects a larger fraction of nearby and brighter galaxies which are missed in part by the UCM Survey, while the lower dispersion of our survey allows us to detect more fainter galaxies with emission.

of the UM objects not selected by our survey are confirmed QSOs with too high redshifts (16 out of 27). Six UM objects (UM 267, UM 270, UM 271, UM 272, UM 277, and UM 279) are possible or probable QSOs, with estimated continuum apparent magnitudes around $m = 18$ and visible neither on the POSS red plates nor on our survey plates. As pointed out by Salzer et al. (1989) more than 80% of the suspected quasars of UM List I, II, III, and IV observed were confirmed as quasars, and none of the 150 candidates observed turned out to be misclassified emission-line galaxies. Three objects (UM289, UM293, and UM298) whose redshifts ($z = 0.062$, 0.0567, and 0.043) are too high for Hα to appear in our survey plates. UM 60 (Mrk 1143) has an equivalent width of Hα+[N II] too low to show the line in the plate since its redshift $z = 0.0376$ moves Hα very near the OP wavelength limit. Finally, another faint undetected galaxy UM 285 ($V = 17.1$) showed emission lines on a poor quality spectrum (Kinman & Hintzen 1981), but there are no measured fluxes. On the other hand, there are seven UCM objects in the field which have not been selected by the UM survey. These objects were labeled 1, that is, Hα line with low contrast in the OP plate. In order to assess the nature of these candidates, spectra were secured for five of them in 1993 November with the INT at La Palma Observatory. Four galaxies showed Hα in emission while one candidate did not. These emission-line galaxies have a low value of the equivalent width of Hα (around 25 Å) but neither Hβ nor [O III] lines in their spectra due to a great amount of extintion. These low-ionization galaxies are easily detected by the surveys in the red but are unnoticed by surveys carried out in the blue.

A search for Markarian galaxies in the same areas covered by the UCM survey has been performed using the NASA/IPAC Extragalactic Database (NED). The total number of Mrk galaxies found is 32, and only 14 of them have been recovered by our survey. To help us to elucidate a possible explanation for the nondetection of these galaxies and to calibrate the survey biases, data for these objects have been collected from the literature, and seven of them were observed spectroscopically in 1993 November at La Palma Observatory. Seven of the 18 Markarian objects undetected by the UCM survey do not present emission lines in their spectra. Mrk 327 (Hutter & Mufson 1981) and Mrk 362 (Mazarella & Balzano 1986) are stars. The spectrum of Mrk 919 obtained by us shows a emissionless continuum and also Mrk 310, Mrk 1145, Mrk 1139, and Mrk 1142 (Markarian et al. 1980, 1988a,b). Another two galaxies have a redshift too high: Mrk 337 at $z = 0.046$ and Mrk 357 at $z = 0.054$ moves the Hα line outside the wavelength range covered by our survey. Mrk 326, Mrk 332, Mrk 331 present saturated spectra in the plates. This effect occurs when the galaxy has a bright red continuum which prevents the line from appearing due to lack of contrast. As the main factor for saturation is surface brightness at the emission region, it is difficult to establish a magnitude limit for saturation. For instance, the spectrum of Mrk 326, a spiral galaxy with a bright and large central condensation, with blue magnitude $m = 13.9$ appears saturated while its near companion Mrk 325, a clumpy irregular galaxy of $m = 13.2$, has been detected by us although some of the knots present saturated spectra. Bright spiral galaxies with the emission coming from the nucleus could be detected by a survey like ours if the exposure time is reduced. Unfortunately, some irregular galaxies with several knots are missed by our survey when the emission regions are located very close along the N-S direction. This is the case for three more galaxies: the peculiar late-type starburst galaxy Mrk 363 which is elongated along the N-S axis with some unresolved H II regions (Pogge & Eskridge 1987, 1993), Mrk 312 with an extremely unusual triangular shape due to the faint starlike nucleus and the two northern arms with blue condensations (Petrosian et al. 1983), and also of Mrk 314 elongated with three condensations along N-S (Petrosian 1981). These galaxies should be detected with the same observational configuration but with the objective prism rotated 90° to yield the dispersion along the E-W axis.

The total flux in the Hα+[N II] blend and its equivalent width are the primary parameters which set the selection effects of a survey like ours (Salzer 1989). To determine the completeness limits of our survey requires an analysis of the bulk of follow-up observational data and will be done elsewhere (Gallego et al. 1993). Two of the remaining three undetected galaxies have an emission line too weak with equivalent widths, as measured by us, of 10 Å for Mrk 344 and 18 Å for Mrk 341. This sets the lower limit for detection of the UCM Survey EW(Hα+[N II]) = 20 Å for galaxies of moderate redshift $z < 0.035$. For galaxies of higher redshift, whose emission lines are located near the red end of the OP spectra, it takes a larger equivalent width emission line to be seen above the continuum since the response function of the IIIaF emulsion and RG630 filter has a sharp edge. It is instructive to compare the results obtained for the pair of galaxies Mrk 1143, undetected by our survey, and Mrk 1144 which are only 80″ appart. Mrk 1143 (UM 60) is a spiral galaxy much brighter than Mrk 1144 (UM 61, UCM 0040+0257) in the red ($r = 15.1$ and 16.8, respectively). Both galaxies have similar redshift, $z = 0.0376$ and 0.0369, very near our detection limit. The analysis of the spectra of these galaxies yields an equivalent width for the Hα+[N II] blend of EW(Hα+[N II]) = 146 Å for Mrk 1144 and EW(Hα+[N II]) = 40 Å for Mrk 1143 setting the lower limit for detection around this value for this redshift. Moreover, there are some galaxies detected by the UCM survey with redshift beyond the $z = 0.04$ nominal limit: Mrk 309 (UCM 2250+2427) with $z = 0.042$ and EW(Hα+[N II]) = 200 Å (Osterbrock & Cohen 1982), UCM 2303+1702 with $z = 0.04211$ and EW(Hα+[N II]) = 185 Å (Zamorano et al. 1992a) and UCM 0139+2226 (UGC 188) with $z = 0.04436$ and unknown but probably very large value of the EW(Hα+[N II]).

As a first approach to study the far-infrared characteristics of the UCM ELGs we searched the *IRAS* PSC within the field of the A195 plate. A total of 24 PSC sources inside the search area were found, mainly normal bright and well-known galaxies. From this sample all were detected by the UCM survey, but only three objects presented Hα emission. All these PSC sources are brighter than $r = 14.5$ mag and previously cataloged. This fact suggested that for a better comparison, more infrared data of the UCM candidates would be needed. These data could be obtained by co-adding the original *IRAS* scans at the locations of each galaxy in our sample leading to the detection of a substantial number of additional sources. The facilities of the Infrared Processing and Analysis Center (IPAC) at the Rutherford Appleton Laboratory were used to develop the work. After this second attempt the final sample of *IRAS*-

detected UCM ELGs inside plate A195 contains 17 objects. Two objects, UCM 0049−0045 and UCM 0053−0049, are located outside the fields covered by *IRAS*. Of the 17 UCM objects with available *IRAS* fluxes, 4 were detected only at 60 μm and 100 μm, 2 were detected at 25 μm, 60 μm, and 100 μm, but not at 12 μm, and 6 had measurable flux in the four bands. There is a high proportion (21 out of 24) of PSC sources with no emission apparent at the UCM survey. This can be explained because *IRAS* also detects bright galaxies with no emission or with their low-resolution spectra saturated in the UCM plates. On the other hand, the UCM survey detects low-luminosity ELGs that are not seen by *IRAS*. These partial results suggest that deep objective-prism surveys such as the UCM survey are not dismissed by the far-infrared results. The important point to be made is that FIR and optical selection techniques are complementary as pointed out by Salzer & MacAlpine (1988), and confirmed by our own studies (Rego et al. 1993; Gallego 1992; Gallego et al. 1993).

5. SUMMARY

In this paper we have described the Universidad Complutense de Madrid survey. A compilation of descriptions and positions is presented for 160 emission-line objects. This is the first list containing the objects which have been identified in the 10 fields surveyed. The total area covered by the survey up to now is 270 deg^2 of sky, yielding a detection rate of six objects per 10 deg^2.

Our survey has been revealed to be able to recover objects already found by similar surveys with different techniques and, what is more important, to discover new objects not previously cataloged. Nearly half of the sample (71 candidates, i.e., 45% of the sample) are galaxies which do not appear in any published catalogue. Only 56 candidates (35% of the sample) are galaxies catalogued by Zwicky.

After a preliminary comparison with the information available for the surveys carried out in Hα, we have shown that the UCM Survey detects a greater fraction of galaxies with emission for fainter $m_z > 15.0$ Zwicky galaxies than the Kinman Survey (41% vs. 12%) while the UCM Survey fails to detect the brighter and nearby galaxies of $m_z < 14.0$ (16% vs. 64%). The fraction for Zwicky galaxies in the magnitude interval 14.0–15.0 is similar for both surveys (around 36%). These differences may be attributed to the higher dispersion of the Kinman Survey (400 Å mm^{-1}) with respect to our survey (1950 Å mm^{-1}), but no final conclusion can be derived since the Kinman lists are not available. The ratio of galaxies with emission to the total number in the field is 34% for our survey, a value greater than the 24% found by Kinman. The overall density of our survey 0.6 ELGs per deg^2 is similar to that found by Kinman (1984a) (over 0.5) and Wamsteker et al. (1985) (around 0.4).

A plate centered in POSS field $\alpha = 0^h50^m$ and $\delta = 0°$ has been taken in order to compare with the University of Michigan (UM) Survey. Up to 12 of the 39 objects found by the UM Survey in the same area are detected by both surveys although with different degrees of confidence. Our survey was not able to detect 26 UM objects: 16 confirmed and six probable QSOs and one emission-line galaxy with too high redshifts, an emission-line galaxy with equivalent width of the line too low for being detected at its redshift, and a very faint ELG whose fluxes have not been published. There are seven UCM objects on the field which were not detected by the UM Survey. The emission in their spectra has been confirmed by us for four out of the five observed galaxies. All of them have weak but detectable Hα line in emission (EW(Hα + [N II]) ~ 25 Å) but neither Hβ nor [O III] lines in their spectra. These results confirm the complementarity of surveys carried out in the blue and in Hα.

A comparison with the Markarian Survey has been performed for all the fields studied in this paper (270 deg^2). Our survey detects 160 emission-line candidates while the Markarian Survey lists 32 galaxies with UV excess. Only 14 Markarian galaxies were recovered by our survey, but seven Markarian objects have no emission lines and two have a too high redshift beyond the UCM Survey limit (z = 0.04). The rest of the Markarian galaxies are three bright ones which appear with saturated spectra in the OP plates, three clumpy irregulars with the close condensations oriented in a North-South axis and three galaxies whose Hα line is too weak to be detected by our survey. Bright irregulars could be detected when at least one of the knots is resolved enough and has no interferring spectra in the parent galaxy. This comparison allowed us to establish our detection limit at EW(Hα + [N II]) > 20 Å for galaxies with redshift $z < 0.035$. Markarian galaxies with redshift $z > 0.035$ are detected but only when the equivalent width of the emission-line is high enough (EW(Hα + [N II]) > 40 Å). Galaxies with a very bright emission line can be detected beyond the nominal limit of the survey, that is, $z > 0.04$.

We have already obtained survey plates in a region near $\alpha = 15^h$ and $\delta = 30°$. A second list of objects found in these fields is in progress. We intend to continue surveying fields in order to cover the two regions delimited by $22^h < \alpha < 2^h$, $15° < \delta < 30°$ and $12^h < \alpha < 18^h$, $20° < \delta < 35°$.

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